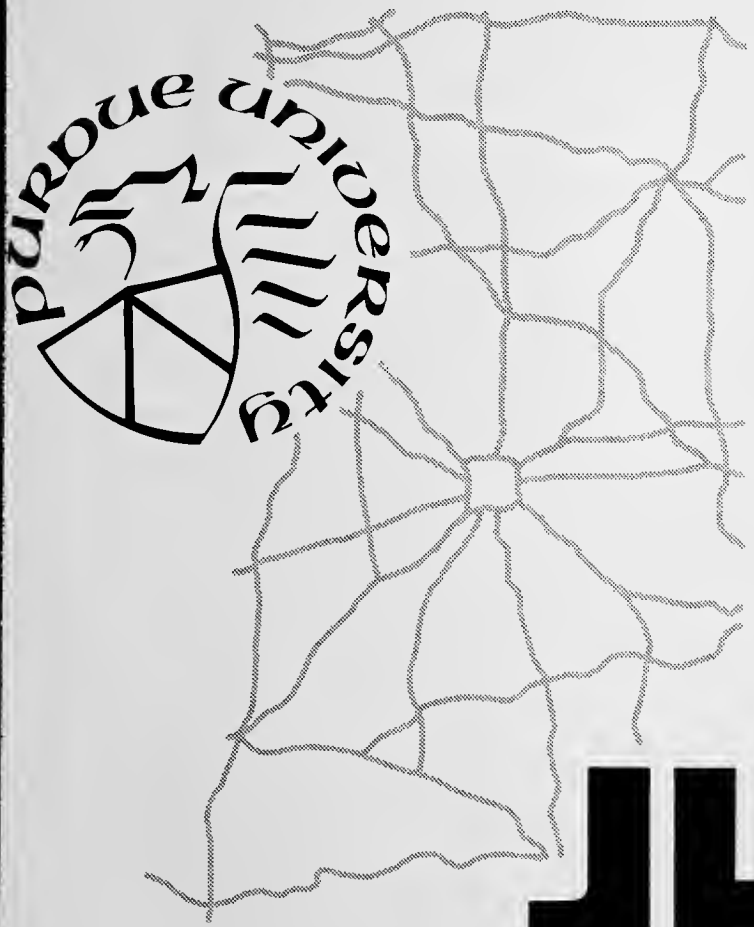
PROMOTION OF ROOTING IN ROOT CUTTING PROPOGATION

SEPTEMBER 1972 – NUMBER 33



BY

R. E. McNIEL

JHRP

JOINT HIGHWAY RESEARCH PROJECT
PURDUE UNIVERSITY AND
INDIANA STATE HIGHWAY COMMISSION

Technical Paper

PROMOTION OF ROOTING IN ROOT CUTTING PROPAGATION

TO: J. F. McLaughlin, Director
Joint Highway Research Project

September 7, 1972

Project: C-36-48C

FROM: H. L. Michael, Associate Director
Joint Highway Research Project

File: 9-5-3

The Technical Paper attached has been prepared by Mr. R. E. McNiel from the research conducted under Part II of the HPR Part II Research Project "Research in Roadside Development and Maintenance". The Paper is titled "Promotion of Rooting in Root Cutting Propagation". The material contained in the Paper has previously been submitted and accepted by the Board in an Interim Report.

The Paper is proposed for publication in the Journal of the International Plant Propagator's Society.

The Paper is submitted for approval of such publication. It will also be forwarded to the ISHC and FHWA for review, comment and approval of publication.

Respectfully submitted,

Harold L. Michael
Associate Director

HLM:ms

cc:
W. L. Dolch
R. L. Eskew
W. H. Goetz
M. J. Gutzwiller
G. K. Hallock
R. H. Harrell
M. L. Hayes
C. W. Lovell
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G. T. Satterly
C. F. Scholer
M. B. Scott
J. A. Spooner
N. W. Steinkamp
H. R. J. Walsh
E. J. Yoder

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by

R. E. McNiel
Graduate Assistant in Research
Department of Horticulture
Purdue University

Joint Highway Research Project
Project No.: C-36-48C
File No.: 9-5-3

Prepared as Part of an Investigation
Conducted by
Joint Highway Research Project
Engineering Experiment Station
Purdue University
in cooperation with the
Indiana State Highway Commission
and the
U.S. Department of Transportation
Federal Highway Administration

Purdue University
West Lafayette, Indiana
September 7, 1972

PROMOTION OF ROOTING IN ROOT CUTTING PROPAGATION

Abstract. Due to shoots developing without the formation of roots during the propagation of some species propagated from root cuttings, growth promoting compounds were applied to root cuttings of Rhus glabra, Sassafras albidum and Comptonia peregrina in order to develop roots. IBA (3-indolebutyric acid), B-Nine (succinic acid-2,2-dimethylhydrazide) and Ethrel (2-chloroethylphosphonic acid) did not cause an increase in the number of cuttings rooted, however, IBA did cause an increase in the number of roots per rooted cutting.

Observations from published (7) and unpublished propagation research have shown that certain woody plant species when propagated from root cuttings will develop shoot growth of a few centimeters without developing a root system. The shoot growth eventually died since the root system did not develop and the result was the lost of a useable plant from each cutting. The purpose of the following research was to determine which growth promoting compounds or combinations would induce root development in woody species.

Auxin at high concentration has been reported to be a strong inhibitor of root development (6,5) except in a few special cases (4,6). Fretz and Davis (4) found greater adventitious root formation with a species of Ilex and Juniper at 2500 and 5000 ppm concentrations applied as a dip. At low concentrations (10^{-10}M), auxin has been found to stimulate root development in special cases (15).

Went (11) originally suggested that factors other than auxin were needed to promote root formation. Little about these other factors has been made completely clear since then, but many compounds and theories have been explored. One category of compounds explored has been phenolic acid used as a synergist with auxin. Leopold (6) and Zenk and Muller (14) have classified the phenolic acids into groups which affect decarboxylation of auxin and those which inhibit growth. Even though salicylic acid has been listed as a growth inhibitor with no synergistic effect (6), Basu, Bose, Roy and Mukhopudhyay (1) found it promoted rooting in combination with auxins.

Ethylene is also classified as a growth substance and has the following effects on root systems: 1) inhibits the elongation of growth in roots, 2) induces the formation of root-hair (10). In addition, workers have found root development to have been affected directly and indirectly by auxin as it affects ethylene and vice versa (2,10,12).

Antimetabolites (B-Nine and others) were first found to inhibit or be ineffective in root formation and development of herbaceous cuttings (3). Recently, however, Reed and Hoysler (8,9) found B-Nine to promote rooting on stem cuttings of three floral crops while other antimetabolites had no effect.

Due to these findings an auxin, an auxin synergist, ethylene and an antimetabolite were selected to study their influence in the promotion of root initiation and development on root cuttings of Rhus glabra L., Comptonia peregrina (L.) Coult., and Sassafras albidum (Nutt.) Ness.

MATERIALS AND METHODS

The plant species chosen were selected for two reasons. C. peregrina and S. albidum were used because of their ability to produce shoot growth without a root system. R. glabra was selected as a control because it had been very successful in its ratio of new plants produced per cuttings planted in earlier studies.

Cuttings from each species were identified to be root tissue by the use of microscopic techniques. C. peregrina roots were obtained from 100 plants, which were collected natively from within the state of Connecticit. R. glabra cuttings were taken from three

nursery grown plants, which were five years old, and S. albidum cuttings were removed from one young native tree. Both of the later plants were obtained in the Lafayette, In. area.

All plants were dug between November 15-19, 1971. While not in transit, all roots were kept at 38°F. Root cuttings for treatment were taken 7 days after digging.

Cuttings were made between 7 and 8 centimeters in length with the diameter varying between 3 and 10 millimeters. Treated cuttings were placed in six-inch deep flats containing a peat:perlite mixture (1:1 v/v). The potting mixture was kept moist by daily hand watering.

Solutions of IBA (3-indolebutyric acid), B-Nine (succinic acid-2,2-dimethylhydrazide), Ethrel (2,chloroethylphosphonic acid) and salicylic acid were applied to the root cuttings at various concentrations and by different application techniques. Ethrel, breaks down evolving ethylene (13) and was the ethylene source. Foliar applications of Ethrel at 50 or 100 ppm or B-Nine at 100 ppm also were made after 2-4 leaves developed on new shoot growth. These cuttings were initially treated with a 15-second dip in deionized water prior to planting and growth development. Controls consisted of a soak for 25 hours and a dip for 15 seconds in deionized water. Table 1 lists all treatments used. All cuttings were submerged during treatment and then allowed to dry for 15-30 minutes prior to planting.

All treatments were replicated 5 times with each replication containing 5 cuttings. Rooting and growth data was taken 16-17 weeks after planting. Data included number of shoots formed, per-

centage of cuttings forming shoots, number roots per cutting, and number of cuttings rooted.

RESULTS AND DISCUSSION

Only fragmented results occured with root cuttings from R. glabra and S. albidium when treated with growth promoting substances (Table 2 and Table 3). The poor response by R. glabra may be due to having a root system too old for good propagation. Hartmann and Kester (5) explained as one of the reasons for the failure of plants to be rejuvenated by root cuttings was because the root pieces were too old. Root cutting propagation of S. albidium is still a mystery. Of the responses, from S. albidium, cuttings produced both shoots and root, others shoot only, and still others root only. No treatments provided a satisfactory increase in rooting of these two plants.

C. peregrina responded extremely well to being propagated by root cuttings during November in a greenhouse. There were no differences in the number of cuttings forming shoots or forming roots between treatments and controls (Table 4). A difference in the number of roots produced did occur.

IBA at 2500 and 5000 ppm increased the number of roots as did the treatment of salicylic acid plus IBA at 2500 ppm (Table 5). Not enough evidence is present to differentiate between a synergistic effect of salicylic acid and the response due solely to IBA at 2500 ppm. Rooting was also influenced by Ethrel at 1000 ppm.

Of the treatments used, none proved to overcome the phenomenon whereby cuttings produce shoots but no roots. However, with C.

peregrina the number of roots produced per cutting was increased when the growth promoting substance IBA was applied at 2500 and 5000 ppm and Ethrel at 1000 ppm.

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Table 1. Treatments applied to root cuttings.

Material	Conc. ppm	Method of Application	Application Time
Deionized Water		dip	15 sec.
Deionized Water		soak	25 hr.
IBA	1	soak	25 hr.
IBA	10	soak	25 hr.
IBA	1,000	dip	15 sec.
IBA	2,500	dip	15 sec.
IBA	5,000	dip	15 sec.
B-Nine	1	soak	25 hr.
B-Nine	10	soak	25 hr.
B-Nine	1,000	dip	15 sec.
B-Nine	2,500	dip	15 sec.
B-Nine	5,000	dip	15 sec.
Ethrel	1	soak	25 hr.
Ethrel	10	soak	25 hr.
Ethrel	1,000	dip	15 sec.
Ethrel	2,500	dip	15 sec.
Ethrel	5,000	dip	15 sec.
Salicylic Acid	10	soak	25 hr.
Salicylic Acid + IBA	10 1,000	soak dip	25 hr. 15 sec.
Salicylic Acid + IBA	10 2,500	soak dip	25 hr. 15 sec.
B- Nine	100	foliar	
Ethrel	50	foliar	
Ethrel	100	foliar	

Table 2. Response of Rhus glabra root cuttings to root promoting substances.

Treatment	No. of Shoots Formed	% of Cuttings Forming Shoots	No. of Roots Formed	% of Cuttings Rooted
IBA 1 ppm	15	28	18	24
IBA 10 ppm	15	36	9	20
IBA 1000 ppm	25	52	1	4
IBA 2500 ppm	43	76	10	24
IBA 5000 ppm	6	20	14	16
B-Nine 1 ppm	13	32	3	8
B-Nine 10 ppm	16	44	16	28
B-Nine 1000 ppm	8	28	17	24
B-Nine 2500 ppm	39	64	30	36
B-Nine 5000 ppm	19	48	5	12
Ethrel 1 ppm	24	68	21	36
Ethrel 10 ppm	5	16	3	4
Ethrel 1000 ppm	8	32	10	8
Ethrel 2500 ppm	29	60	12	20
Ethrel 5000 ppm	2	8	6	8
Salicylic acid	14	36	8	20
Sali acid-IBA 1000 ppm	40	64	21	36
Sali acid-IBA 2500 ppm	25	48	4	12
H_2O_{15}--B-Nine 100 ppm	20	64	41	40
H_2O_{15}--Ethrel 50 ppm	30	52	19	16
H_2O_{15}--Ethrel 100 ppm	2	8	1	4
H_2O--15 sec. dip	26	60	16	28
H_2O--24 hr. soak	14	36	21	32

Table 3. Response of Sassafras albidium root cuttings to root promoting substances.

Treatment	No. of Shoots Formed	% of Cuttings Forming Shoots	No. of Roots Formed	% of Cuttings Rooted
IBA 1 ppm	0	0	0	0
IBA 10 ppm	1	4	3	4
IBA 1000 ppm	0	0	0	0
IBA 2500 ppm	3	12	2	8
IBA 5000 ppm	3	12	10	16
B-Nine 1 ppm	0	0	0	0
B-Nine 10 ppm	1	4	0	0
B-Nine 1000 ppm	0	0	6	12
B-Nine 2500 ppm	2	8	2	8
B-Nine 5000 ppm	3	8	4	16
Ethrel 1 ppm	4	8	4	8
Ethrel 10 ppm	0	0	1	4
Ethrel 1000 ppm	0	0	0	0
Ethrel 2500 ppm	0	0	0	0
Ethrel 5000 ppm	1	4	1	4
Salicylic acid	0	0	0	0
Sali acid--IBA 1000 ppm	0	0	0	0
Sali acid--IBA 2500 ppm	1	4	8	8
H_2O_{15}--B-Nine 100 ppm	3	12	8	12
H_2O_{15}--Ethrel 50 ppm	1	4	12	24
H_2O_{15}--Ethrel 100 ppm	2	8	10	20
H_2O--15 sec. dip	2	8	7	4
H_2O--24 hr. soak	1	4	1	4

Table 4. Response of Comptonia peregrina root cuttings to root promoting substances.

Treatment	No. of Shoots Formed	% of Cuttings Forming Shoots	Ave. No. of roots per rooted cutting	% of Cuttings Rooted
IBA 1 ppm	28	72	6.2	84
IBA 10 ppm	38	96	6.4	92
IBA 1000 ppm	32	84	5.9	88
IBA 2500 ppm	31	80	8.2	76
IBA 5000 ppm	35	92	11.5	92
B-Nine 1 ppm	40	80	6.0	96
B-Nine 10 ppm	44	80	3.8	80
B-Nine 1000 ppm	36	84	5.7	100
B-Nine 2500 ppm	33	76	5.5	60
B-Nine 5000 ppm	23	76	4.6	88
Ethrel 1 ppm	37	84	5.7	84
Ethrel 10 ppm	30	64	4.8	76
Ethrel 1000 ppm	34	80	9.0	72
Ethrel 2500 ppm	30	60	4.7	84
Ethrel 5000 ppm	27	52	4.5	72
Salicylic acid	46	100	4.3	92
Sali acid--IBA 1000 ppm	29	80	6.6	76
Sali acid--IBA 2500 ppm	31	84	8.7	100
H_2O_{15}--B-Nine 100 ppm	10	45	3.5	75
H_2O_{15}--Ethrel 50 ppm	39	80	3.8	72
H_2O_{15}--Ethrel 100 ppm	24	70	5.0	75
H_2O--15 sec. dip	25	68	3.0	56
H_2O--24 hr. soak	34	80	4.0	84

Table 5. Number of roots formed on C. peregrina root cuttings when treated with root promoting substances.[z]

Material		Ave. No. of roots formed per replication
IBA	5000	53.2 a
Salicylic Acid + IBA	2500	43.4 ab
Ethrel	1000	32.4 bc
IBA	2500	31.2 bc
IBA	10	29.6 bc
B-Nine	1	28.8 bcd
B-Nine	1000	28.6 bcd
IBA	1	26.2 bcd
IBA	1000	25.8 bcd
Salicylic Acid + IBA	1000	25.0 bcd
Ethrel	1	23.8 bcd
B-Nine	5000	20.2 cd
Ethrel	2500	19.8 cd
Salicylic Acid		19.8 cd
Ethrel	100	18.8 cd
Ethrel	10	18.2 cd
H_2O soak		17.0 cd
B-Nine	2500	16.6 cd
Ethrel	5000	16.2 cd
B-Nine	10	15.2 cd
Ethrel	50	13.6 cd
B-Nine	100	13.0 cd
H_2O dip		8.2 d

[z]Means in each column with different letters differ at the 1% level.